Mathematics III - Video course

COURSE OUTLINE

Sl no.	Topics and Contents	No of lectures	No of Modules
1	Complex Numbers and Complex Algebra: Geometry of complex numbers, Polar form, Powers and roots of complex numbers.	1	1
2	Complex Functions: Limits of Functions, Continuity, Differentiability, Analytic functions, Cauchy-Riemann Equations, Necessary and Sufficient condition for analyticity, Properties of Analytic Functions, Laplace Equation, Harmonic Functions, Finding Harmonic Conjugate functions	5	1
3	Elementary Analytic Functions: Exponential, Trigonometric, Hyperbolic functions and its properties. Multiple valued function and its branches - Logarithmic function and Complex Exponent function.	4	1
4	Complex Integration: Curves, Line Integrals (contour integral) and its properties. Line integrals of single valued functions, Line integrals of multiple valued functions (by choosing suitable branches). Cauchy-Goursat Theorem, Cauchy Integral Formula, Liouville, FTA, Max/Min Modulus Theorems.	5	1
5	Power Series: Convergence (Ordinary, Uniform, Absoulte) of power series, Taylor and Laurent Theorems, Finding Laurent series expansions.	2	1
6	Zeros, Singularities, Residues: Zeros of analytic functions, Singularities and its properties, Residues, Residue Theorem, Rouche's Theorem, Argument Principle.	2	1
7	Applications of Contour Integration: Evaluating various type of indefinite real integrals using contour integration method.	4	1
8	Conformal Mapping and its applications: Mappings by elementary functions, Mobius transformations, Schwarz-Christofel transformation, Poisson formula, Dirichlet and Neumann Problems.	5	1
9	Solution in Series: Second order linear equations with ordinary points, Legendre equation, Second order equations with regular singular points, The method of Frobenius, Bessel equation.	4	1
10	Properties of Legendre Polynomials and Bessel Functions	2	1
11	Fourier Series: Orthogonal Family, Fourier Series of 2? periodic functions, Formula for Fourier Coefficients, Fourier series of Odd and Even functions, Half-range series, Fourier series of a T-periodic function, Convergence of Fourier Series, Gibb's Phenomenon, Differentiation and Integration of Fourier series, Complex form of	4	1

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Basic courses(Sem 1 and 2)

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	Fourier series.		
12	Fourier Transforms: Fourier Integral Theorem, Fourier Transforms, Properties of Fourier Transform, Convolution and its physical interpretation, Statement of Fubini's theorem, Convolution theorems, Inversion theorem, Laplace Transform.	4	1
13	Second order PDE: Second order PDE and classification of 2nd order quasi-linear PDE (canonical form)	1	1
14	Wave Equation: Modeling a vibrating string, D'Alembert's solution, Duhamel's principle for one-dimensional wave equation.	2	1
15	Heat Equation: Heat equation, Solution by separation of variables.	2	1
16	Laplace Equation: Laplace Equation in Cartesian, Cylindrical polar and Spherical polar coordinates, Solution by separation of variables.	3	1
17	Solution by Transform Methods: Solutions of PDEs by Fourier and Laplace Transform methods.	2	1